Optimization calculations on a computer cluster

Jarosław Jajczyk

Faculty of Electrical Engineering, Poznan University of Technology, Piotrowo 3A, Poland, e-mail: jaroslaw.jajczyk@put.poznan.pl

Abstract: **The work presents a way of performing optimization calculations on a parallel computer of the cluster type. What is more, it presents sample results describing the efficiency of paralleling the optimization process.**

Keywords: **optimization, genetic algorithm, computer cluster, parallel computing.**

I. INTRODUCTION

Using computers to solve any problems connected with designing devices has become common. Thanks to computer technologies, calculation results can be obtained faster and with a higher level of precision. Computers and numerical calculations are particularly useful in solving complex problems. The complexity of computer calculations often results in the long waiting time before the results are available. That is when parallel computing becomes beneficial.

Paralleling the calculations, including optimization calculations, is often a task that is difficult to accomplish due to the complexities resulting from the need to exchange data between the computers. An efficient solution to this problem is combining parallel computing and optimization by means of the genetic algorithm (GA) method. The work presents the results of paralleling optimization calculations of the high current busduct.

II. ORGANIZATION OF OPTIMIZATION CALCULATIONS

Optimization with the use of the GA method involves calculating the solution quality factors (specimens) that create a certain pool (a population) of solutions on the basis of which the next generation is built [1]. What is characteristic for the GA method is the fact that the calculations of the adaptation of particular specimens are performed independently. This principle can be successfully used for paralleling the calculations.

In the present work, a centralized organization of a parallel GA (Fig. 1) was used. In this case, one computer on which the main process is running, is responsible for all genetic operations and for distributing the tasks to other computational units which are responsible for calculating the specimen adaptation factors [1], [2], [3].

III. CALCULATION RESULTS

As part of the present work, an optimization of the geometric dimensions of an unshielded three-phase busduct with solid insulation characterized by properties constituting a compromise between operational costs and material costs was performed. Details regarding the optimization of this type of busduct were presented in [2]. For calculation purposes, the following values were used: phase current: 6 kA; line voltage: 15 kV; service life: 10 years; phase wires made of copper and the insulation made of epoxy resin.

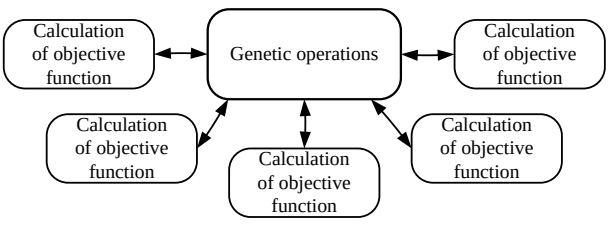

Fig. 1. The organization of the parallel genetic algorithm

The calculations were performed on a computer cluster consisting of 12 computers connected by means of a high speed computer network. All the computers were equipped with the Intel i5 processor and 8 GB RAM. Every population consisted of 50 specimens and the calculations were performed for 40 generations. The computation time and the fluctuations of the speedup in relation to the number of nodes were examined (Fig. 2).

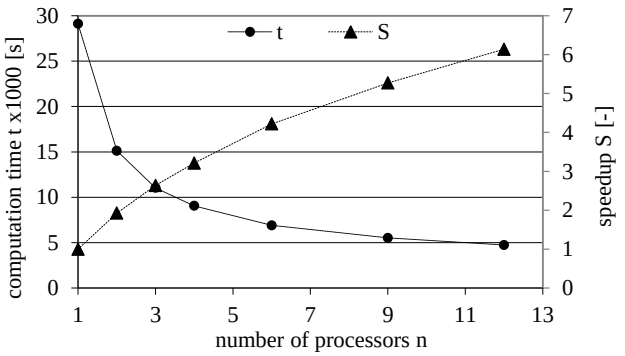

Fig. 2. The computation time (t) and the speedup factor (S)

IV. CONCLUSION

The genetic algorithm is an efficient method of searching for an optimum in the global sense. Thanks to the application of parallel computing, an improvement in the optimization efficiency was achieved (shortening the calculation time). Increasing the number of computers that are part of the cluster accelerates the optimization process. The acceleration is not proportional to the number of computers (Fig. 2). It was observed that despite the fact that 12 computers were used, the acceleration slightly exceeded the value of 6.

V. REFERENCES

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